

Headquarters U.S. Air Force

Integrity - Service - Excellence

Building Sustainability into the Air Force Remediation Process

**Year of the Air Force
Family**



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AFCEE/TDV
Environment, Energy and Sustainability Symposium (E²S²)

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Overview

- AF Environmental Restoration Program (ERP)
- AF Green and Sustainable Remediation (GSR)
- GSR in AF ERP
- GSR Technology
- GSR Through Optimization



■ In-depth Case Study: Travis AFB

- Necessary
- Optimization
- GSR Treatment Train
 - In situ Bioreactor → Phytoremediation → Biobarrier
- Wrap-up

■ Future Direction

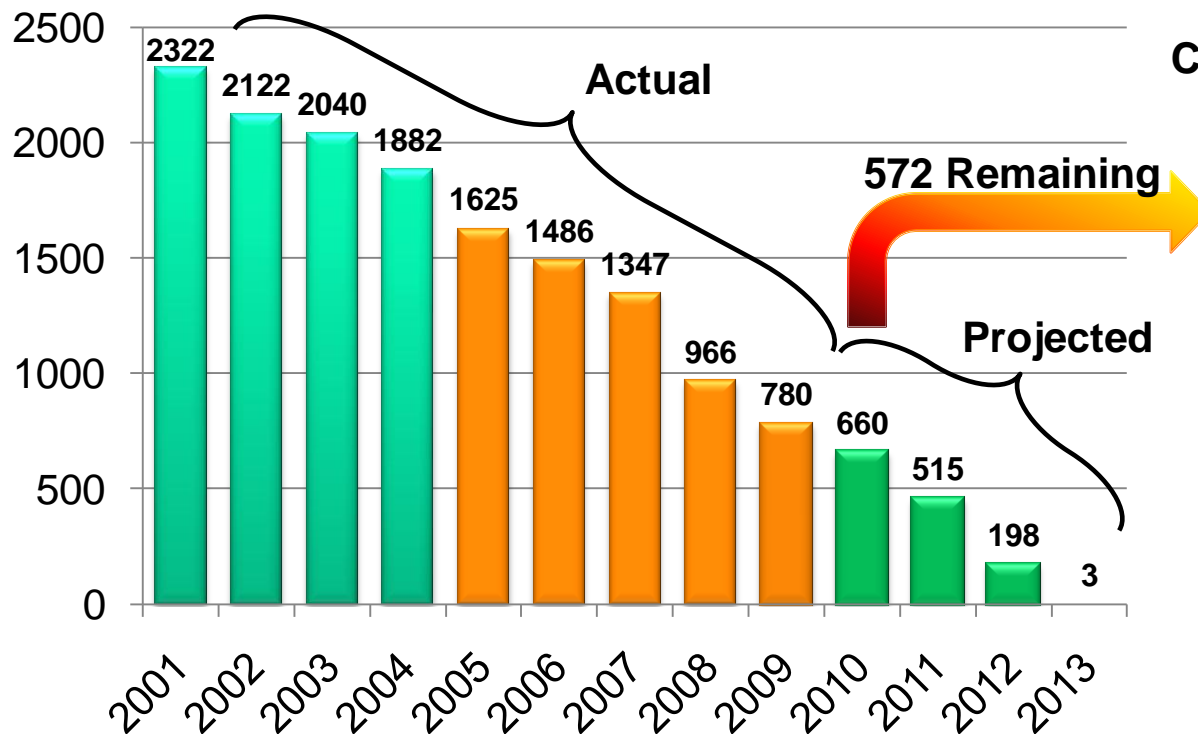


AF Environmental Restoration Program (ERP)

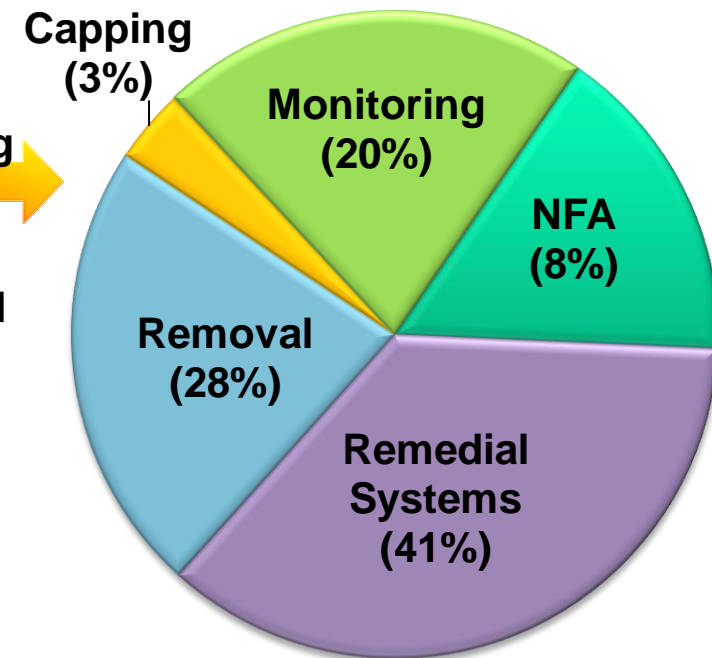
- **Installation Restoration Program (IRP) – 572 sites in 2010**
 - **6,078 sites closed, response complete, or RIP**
 - **Cleanup of pre-1986 contaminated sites**
 - **Achieve Remedy-in-Place (RIP) by 2012**
- **Compliance Restoration Program (CRP) – 952 sites in 2009**
 - **Compliance cleanup sites (post-1986 releases)**
- **Military Munitions Response Program (MMRP) – 455 open munitions response sites**
 - **Cleanup of non-operational ranges**
 - **Achieve RIP/Response Complete (RC) by 2020**
- **FY10 Budget: \$414M for 648 active projects**



Non RIP Sites at Start of FY



91% of sites
have achieved RIP



Anticipated Remedies



System Inventory Costs 381 Remedial Systems in Operation*

38%

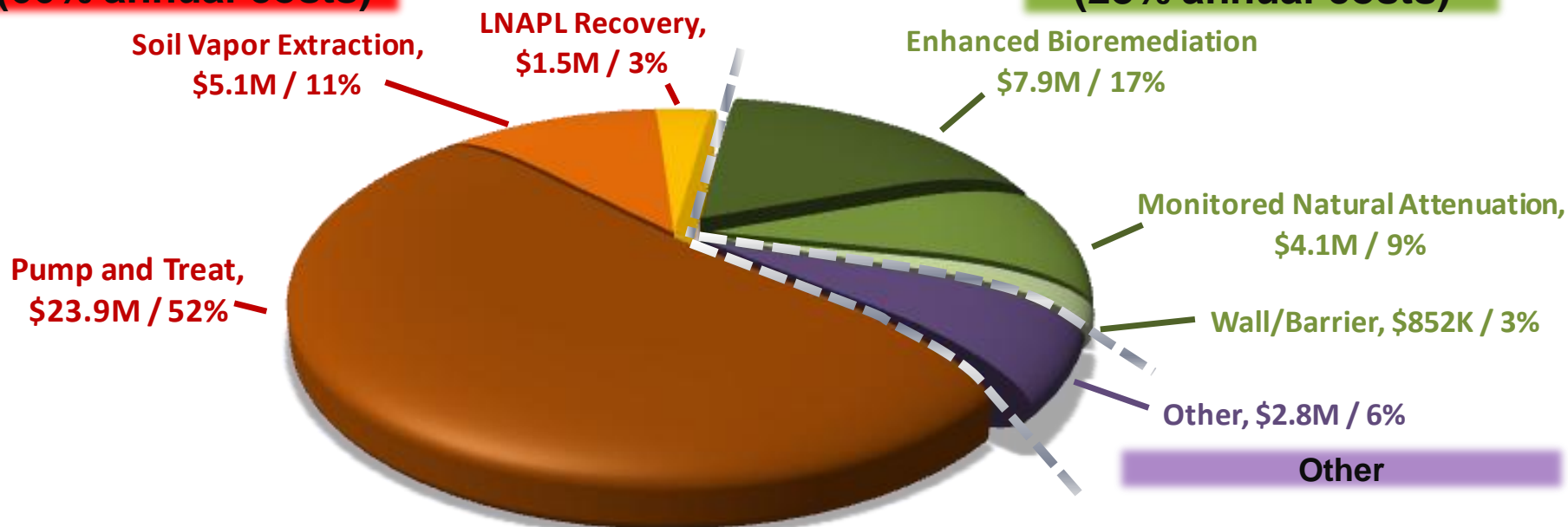


**Energy Intensive
(66% annual costs)**

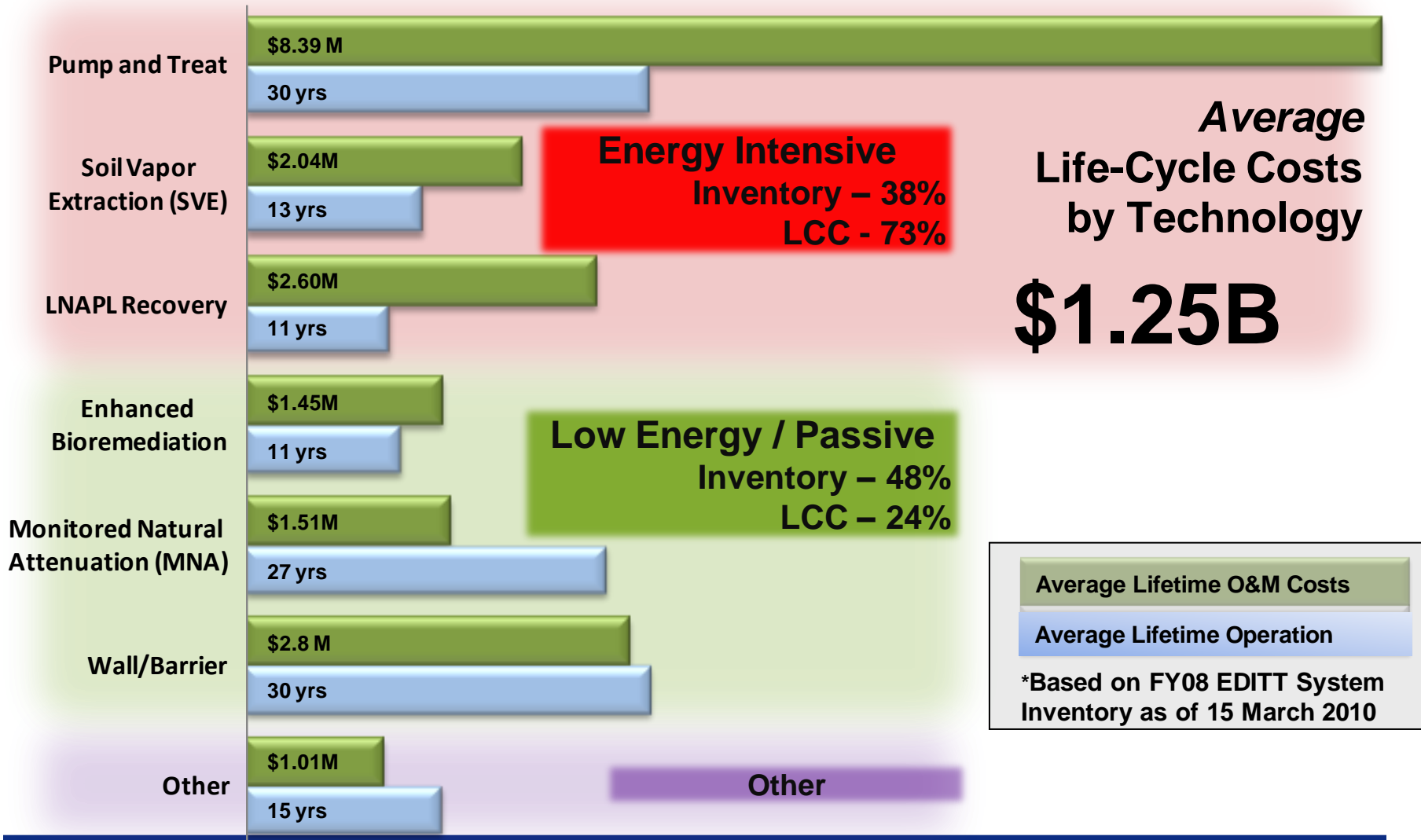
48%



**Low Energy / Passive
(28% annual costs)**



*Based on FY08 EDITT System
Inventory as of 15 March 2010

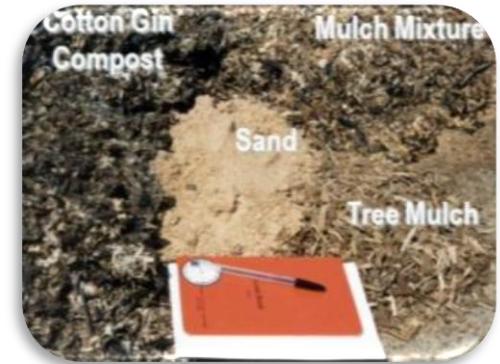




Green and Sustainable Remediation (GSR) in AF ERP

- **US EPA defines Green Remediation**
 - Practice of considering all environmental effects of remedy implementation and incorporating options to minimize the environmental footprint of a cleanup

- **USAF would change it slightly to:**
 - Practice of considering all environmental effects of remedy implementation and operation incorporating options to minimize the environmental footprint of a cleanup



Solar-powered in situ
bioreactor at Altus AFB, OK

... thereby ensuring operational performance is sustainable



- **Overarching goal – protect human health and environment**
- **Key elements of the GSR initiative to minimize:**
 - ***Energy use for treatment systems***
 - ***Water use/impacts on water resources***
 - ***Material consumption/waste generation***
 - ***Impacts on *land* and ecosystem***
 - ***Air emissions***
- **Objective – Incorporate GSR *technologies* as part of holistic approach to *optimize* cleanup**
 - ***Technology-driven (green)***
 - ***Process-centric (sustainment)***



GSR through Technology

Goals

- Accelerate **greener** Remedy-in-Place (RIP)
- Augment current remedies to achieve Response Compete (RC)
- Lower capital and O&M costs
- Move from energy-consumptive to energy-efficient technologies
- Promote education and transfer of successful solutions and lessons learned

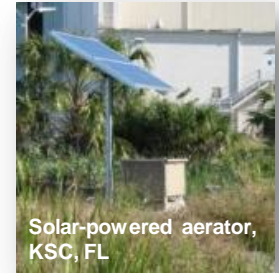
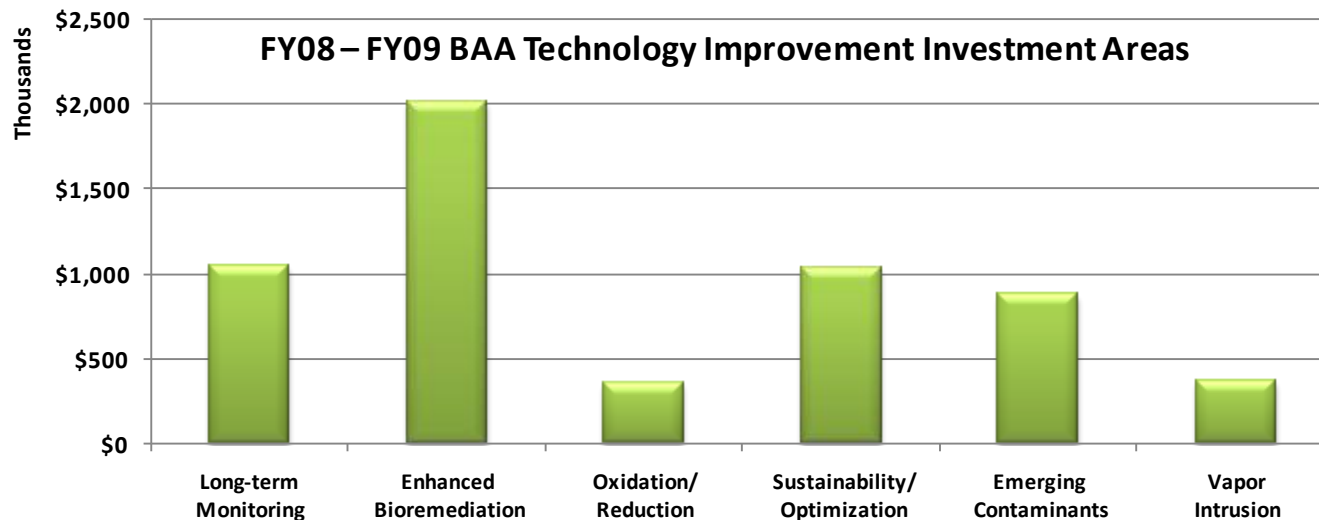




GSR through Technology

Broad Agency Announcement (BAA) for USAF Environmental Restoration Program Innovation

- Contract mechanism for dem/val of innovative technologies
 - Identify BETTER, FASTER, CHEAPER, & GREENER solutions
 - Appears in FedBizOps
 - Awards based on: technical merits and broad spread application
 - \$3M-\$4M/yr AFCEE -- leveraged -- \$36M (total) SERDP/ESTCP





GSR through Optimization

Environmental Restoration Program Optimization (ERP-O)

- A ***comprehensive and systematic*** review of an installation's cleanup activities
- Return natural infrastructure resources to ***beneficial use***
- Promote and incorporate ***sustainability principles***
- Ensure remedy ***effectiveness***, first
- Optimize remedy ***efficiency***, second



Focus is on PERFORMANCE ... which drives COSTS



Case Study: Travis AFB

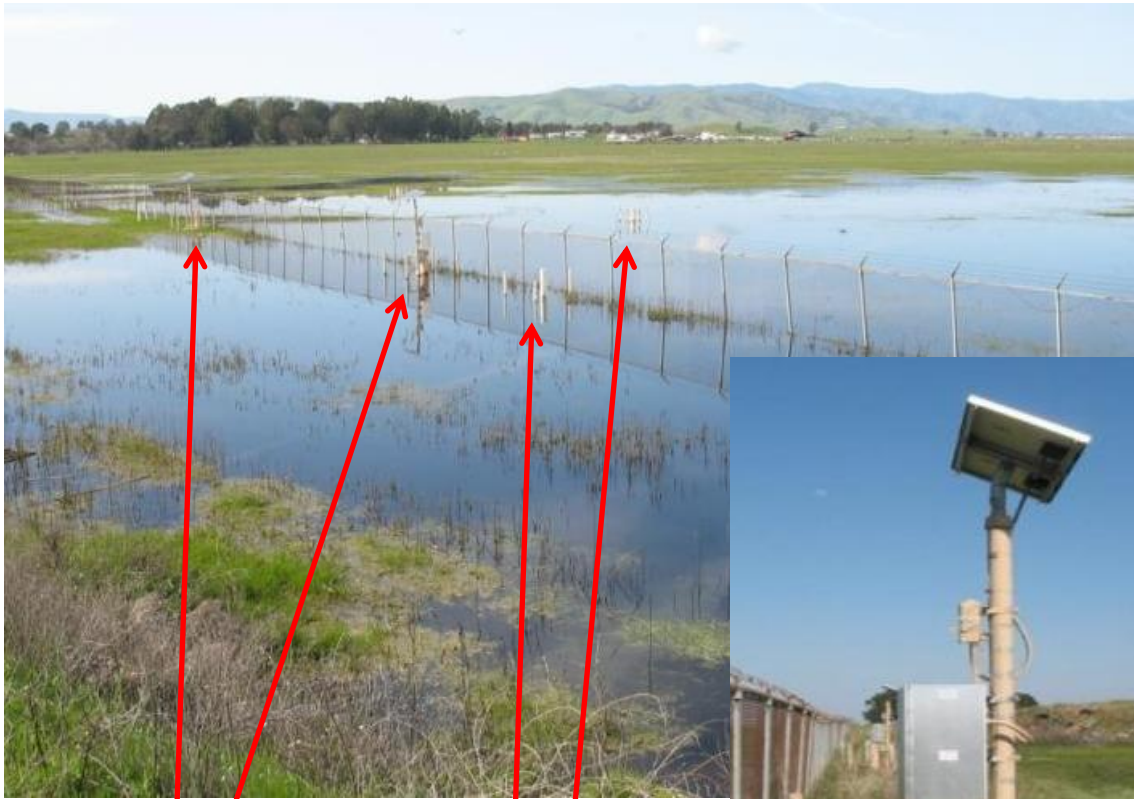
Goals

- Out of necessity
- Reduce energy consumption, air emissions, material consumption and waste generation
- Improve performance of existing remedial technologies
- Improve cost effectiveness
- Reduce impacts on water resources, land and ecosystems
- Reach RIP and RC in a more sustainable manner as decreasing concentrations will allow
- Multiple reasons for selecting or transitioning to sustainable technology





Solar Powered Well at Base Boundary



Extraction Wells

**Monitoring
Wells**



- **Example of GSR out of necessity**
- **Vernal pool covers most of on- and off-base site boundary**
- **Solar solution avoided regulatory hurdles and reduced impact on sensitive ecosystem**



Transition to Low Conc/ Low Vol Operations

- At start of base GW remediation, plumes large and heavily contaminated
- Centralized GW treatment offered economy of scale and easier O&M
 - >1.17 billion gals of GW treated
 - >12 thousand lbs of solvents removed
- Over time, extraction systems effectively removed contaminant mass-plumes shrank-hot spots “cooled”
- Over time, influent concentrations and volumes decreased and maintenance/repair costs increased
- ERP-O helped with transition to more sustainable technology
 - “Time to trade in the old SUV for a new Prius”



North Treatment Plant Before Optimization



- NGWTP removed over 500 lbs of VOCs from 2000-2007
- **In 2008 NGWTP removed ½ lb of VOCs!**

- 82 M gal water treated since 2000
- \$100K/lb VOC removed
- 10K kWh of electricity consumed monthly
- 13K lbs of CO₂ generated monthly



North Treatment Plant After Optimization



- 80k gals of water will be treated monthly
- Significantly reduced cost/lb VOC removed
- No off grid electricity used for treatment
- No CO₂ generated by solar powered treatment



Central Treatment Plant Before Optimization



- UV Oxidation primary treatment technology
- Max plant capacity 300 GPM
- Plant usage 80 GPM
- O&M costs significant
 - UV bulbs \$2k/ea
- Treated water previously used for irrigation, stopped as DERA funding could not be used beyond treatment



Central Treatment Plant After Optimization

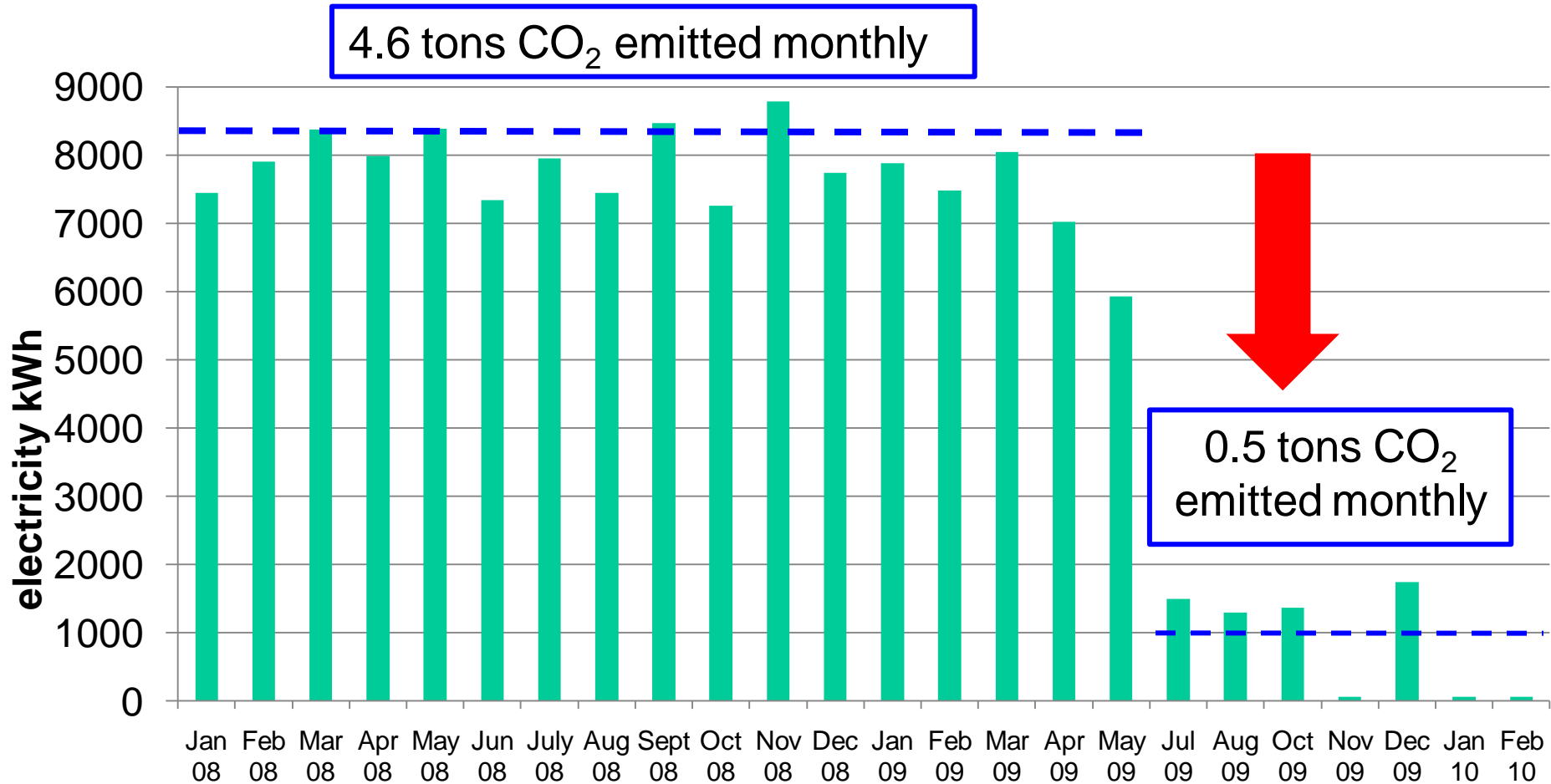


- Turned off electricity intensive UV/Ox system
- Utilized two existing 20K lb canisters
- Significant reduction in electricity consumption and O&M costs

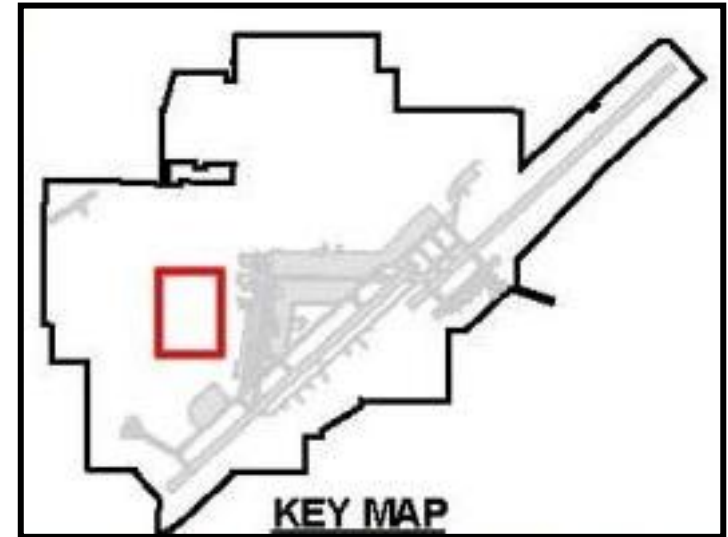


Central GW Treatment Plant

Ultra-Violet Oxidation



GSR Demo Site



Train Treatment Design

- Bioreactor
- Phytoremediation
- Biobarrier



GSR Demo Site: In situ Bioreactor



- **Battery acid neutralization sump**
- **Chlorinated solvents discharged to sub-surface resulted in TCE DNAPL**
- **TCE concentrations initially ranged from 5 - 240,000 ppb**



GSR Demo Site: In situ Bioreactor

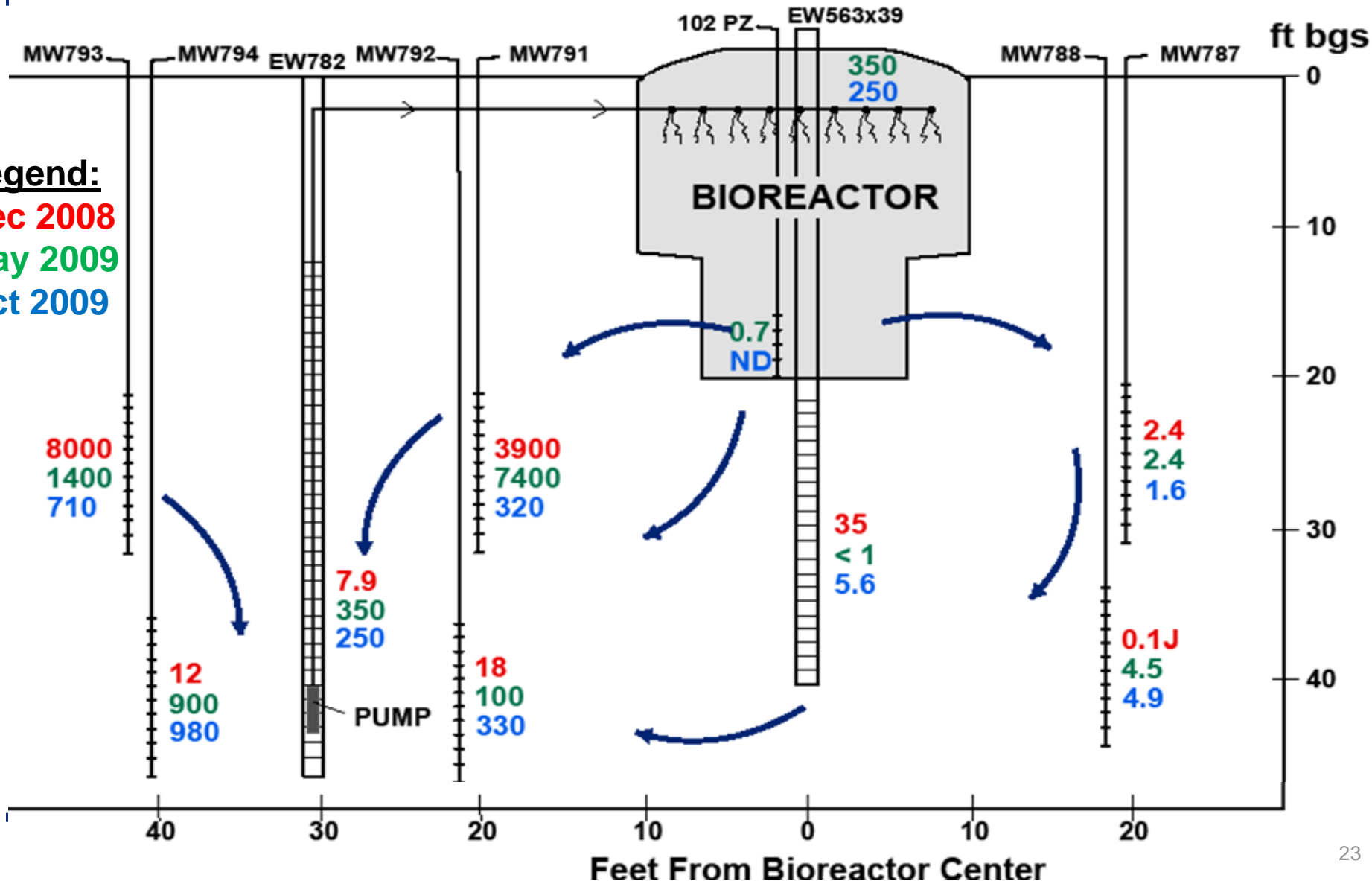


- Solar-powered biogeochemical source area treatment system
- Mix mulch, gravel, iron and gypsum promote reductive dechlorination both by biotic and abiotic processes
- Selected as GSR case study by EPA Region 9



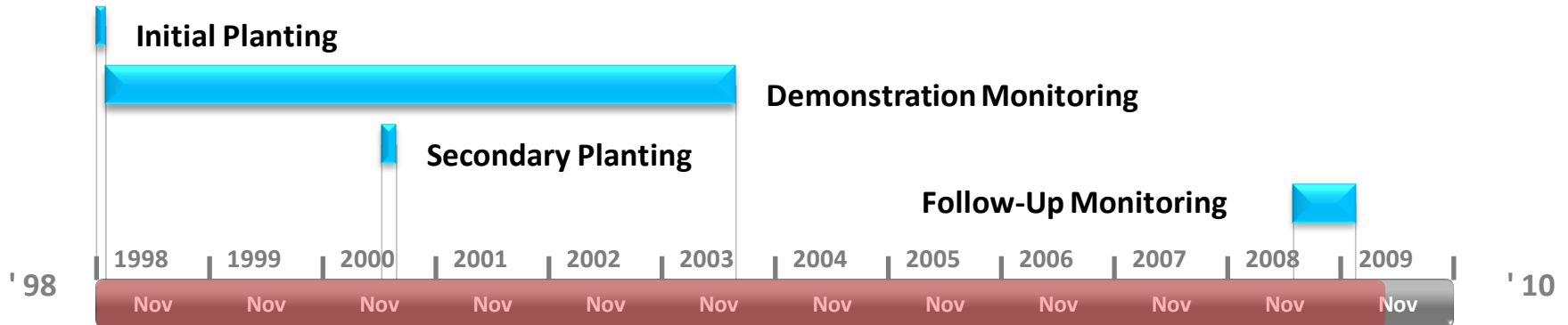
GSR Demo Site: In situ Bioreactor - TCE $\mu\text{g/L}$ in GW

Legend:
Dec 2008
May 2009
Oct 2009

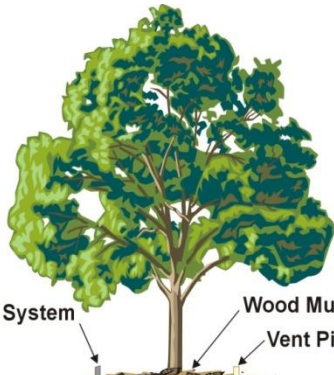




GSR Demo Site: Phytoremediation



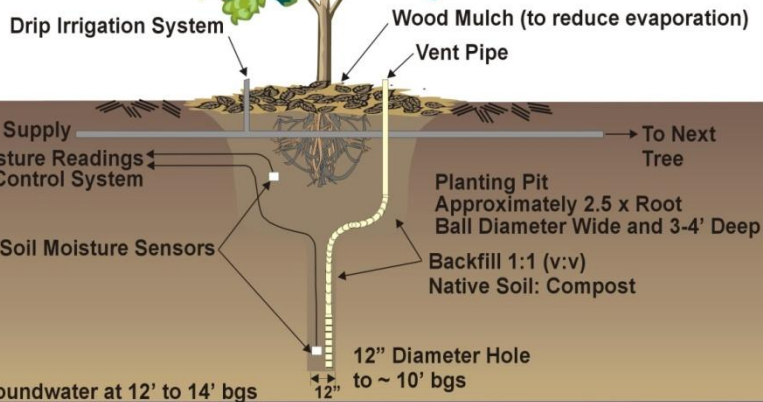
Planting:
15-Gallon
Size Tree



Trees: 480

Area: 2.2

**Type: *Eucalyptus sideroxylon*
'Rosea'**

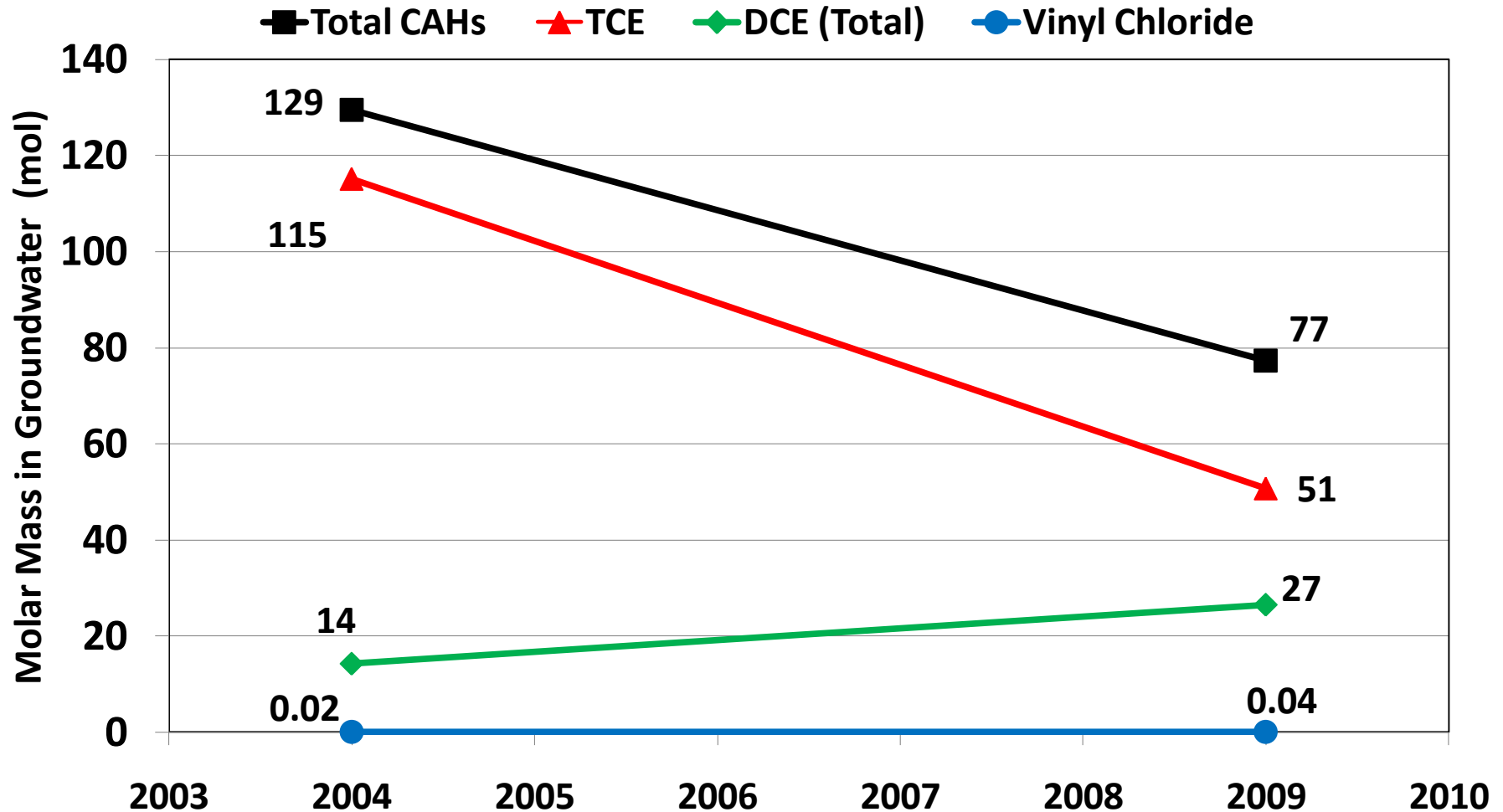


Dissolved Phase Contamination



GSR Demo Site: Phytoremediation

Total Plant Stand Area





GSR Demo Site: Biobarrier

- Total 13 injection wells are being installed
- Inject emulsified vegetable oil
- After 3-4 rounds of sampling to validate the technology
- Travis AFB will propose the train treatment design as a ROD to EPA Region 9

**Demonstrations DO NOT
work every time!!**

- Installation permeable treatment wall using jet grout applicator
- Zero valent iron slurry pumped across solvent plume
- Grout stopped flow of GW through reactive media:
 - **“Successful” failure**





Travis AFB Wrap-Up: Think Big Picture!



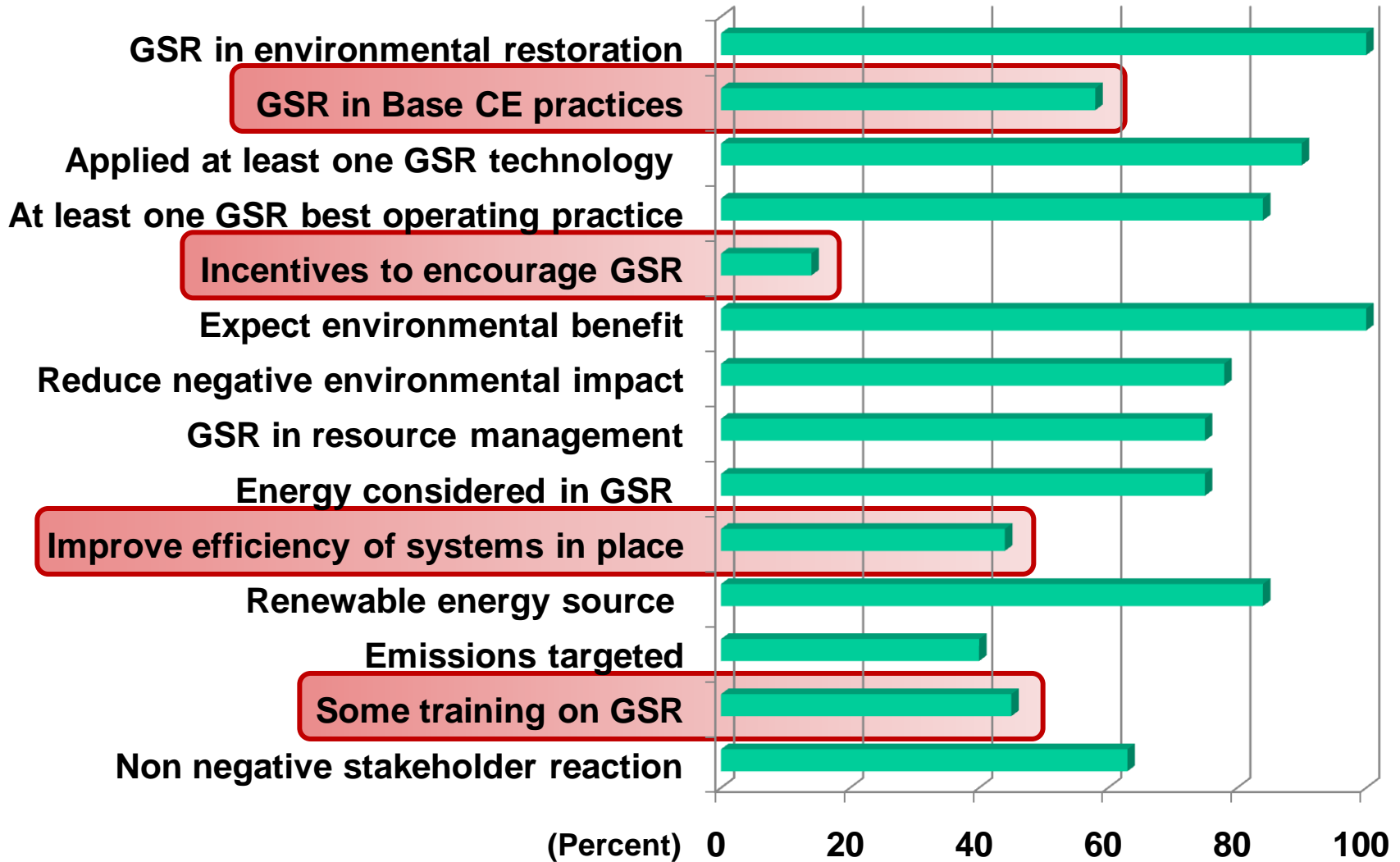
- GSR really just common sense and BMPs
- Energy consumption reports along with resulting CO₂ generation from treatment plant operation at monthly regulatory meetings – A real “Eye Opener”
- AFCEE BAAs energize GSR selection process
- Regulatory agencies can be very receptive to GSR initiatives
- Performance-based contracts build GSR into your ERP

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GSR – Future Direction





GSR – Future Direction

Contract language

- **Develop sample contract language for GSR considerations**
- **Regionalize RAO/LTM contracts to optimize monitoring programs and eliminate high energy engineered remediation systems**
 - **Incentivized through PBC**
- **Considering award program to incentivize contractors to incorporate sustainable practices into environmental projects/contracts**

Partnerships

- **Interstate Regulatory & Technology Council (ITRC)**
- **American Society for Testing and Materials (ASTM)**
- **Sustainable Remediation Forum (SuRF) – Industry-led**
- **US EPA**
- **Services and agencies**

AF GSR policy



Outreach

- More than \$7M BAA investment since 2008 ERA transformation
 - Current projects: www.afcee.af.mil/resources/technologytransfer/baa
 - Solicitation: www.afcee.brooks.af.mil/pkv/baa/
- AFCEE Green and Sustainable Remediation Website
- Developing fact sheets and decision framework within context of ERP-O
- Web-based training in development
- 2010 and 2011 AF Restoration Technology Transfer Workshop and other training
- AFCEE Technology Transfer Newsletter





AFCEE Technology Transfer:

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AFCEE ERP-O Website

www.afcee.af.mil/resources/restoration/erp-o/index.asp

AFCEE Sustainable Remediation Website

www.afcee.af.mil/resources/technologytransfer/programsandinitiatives/sustainableremediation/index.asp

EPA on Green Remediation

www.clu-in.org/greenremediation/

ITRC on Green Sustainable Remediation

www.itrcweb.org/teampublic_GSR.asp



Questions?

